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Sampling, Distribution, Dispersal

Flesh Flies (Diptera: Sarcophagidae) From the Brazilian Amazonian Savannas, a Poorly Sampled and Threatened Environment

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Abstract

The Amazonian region is composed by many kinds of environments, including the Amazonian savannas, which comprise about 5% of the Amazon biome in Brazil. The biota of Amazonian savannas is poorly known, especially for insects. In this study, we performed a faunistic inventory of flesh flies (Diptera: Sarcophagidae) of four Brazilian Amazon savannas, where we recorded two subfamilies, 16 genera, and 40 species, two of which are described as new to science: *Lepidodexia* (*Notochaeta*) *helenae* sp. nov. and *Lipoptilocnema augustoi* sp. nov. *Oxysarcodexia graminifolia* Souza, Pape & Thyssen, 2020 is recorded for the first time for Brazil. *Dexosarcophaga paulistana* Lopes (1982), *Helicobia biplagiata* Dodge, 1966, *Helicobia cearensis* Tibana, 1976, *Oxysarcodexia simplicoides* (Lopes, 1933), and *Oxyvinia excisa* (Lopes, 1950) are newly recorded for the Brazilian Amazon. *Oxysarcodexia nitida* Soares & Mello-Patiu, 2010 is a new record for the state of Pará. The species *D. paulistana* is redescribed, and photographs and detailed illustrations of male terminalia are provided.

Key words: *cerrado*, Miltogramminae, new record, flesh fly, Sarcophaginae

The Amazon region covers almost 7 million km² and it is renowned for being one of the most planet's biodiverse regions (Mitermeier et al. 2003). One of the hypotheses evocated to explain this current high diversity is the mosaic of differentiated habitats with distinct ecological and edaphic conditions, inserted within the high-biomass tropical forested matrix (Gentry 1981, Remsen and Parker 1983, Rosenberg 1990, Tuomisto et al. 1995, Clark et al. 1998, 1999; Fine et al. 2010). These differentiated environments function as 'islands', where their species become isolated, for different reasons and at different times along Amazonian history, from their ancestral populations and subsequently had diverged. The differentiated environments can be roughly divided into forested (e.g., flooded-forests, mountain cloud forests, and dry forests) and open vegetation types (e.g., white-sand enclaves, rocky outcrops, llanos, and savannas [(locally known as *cerrado*]) (Anderson 1981, Pires and Prance 1985, Terborgh and Andresen 1998, Carvalho and Mustin 2017). Compared to the forested environments, the open vegetation types are often highly idiosyncratic and species-poor, but they show high rates of endemism (Anderson 1981, Carvalho and Mustin 2017).

The savannas of lowland Amazonia are patchily distributed, representing about 267,164 km² of this region (Carvalho and Mustin 2017), and they are usually grouped under the broader definition 'Amazonian savannas' (Pires and Prance 1985), even though Amazonian savannas have different origins, structural complexity, geomorphology, isolation rate, and biota composition (Werneck et al. 2012, Bueno et al. 2017, Buzatti et al. 2018, Resende-Moreira et al. 2019). For this reason, they have received distinct classifications, which are based mainly on the composition of their flowering plants (Amaral et al. 2019, Devecchi et al. 2020). This is because higher plants and vertebrates (mainly birds) are among the most studied taxa in Amazonian savannas (Carvalho and Mustin 2017).

Sarcophagidae is one of the largest families of Calyptrate flies with more than 3,000 described species distributed in all continents,

except the Arctic and Antarctic (Pape et al. 2011, Yan et al. 2020). Their diversity is markedly higher in warmer climates (Yan et al. 2020), where sarcophagids are particularly abundant in sunny and open habitats, such as clearings, farms, and savannas (Sousa et al. 2011, 2016; Vasconcelos et al. 2015, Dufek et al. 2016). They are popularly known as flesh flies because several species from different genera in all three subfamilies are sarcosaprophagous, feeding on vertebrate carrion (Yan et al. 2020).

Several studies have been published or are in progress on the sarcosaprophagous species of Sarcophagidae visiting vertebrate carrion, mainly pig carcasses in forensic studies, in the savannas of southern and central Brazil (Barros et al. 2008, Rosa et al. 2011, Mello-Patiu et al. 2014, Faria et al. 2017, Paseto et al. 2019). On the other hand, the flesh fly fauna of Amazonian savannas remains neglected. Carvalho-Filho et al. (2018) published a study on the flesh flies found in a white-sand enclave from the eastern Amazon, where four new species and new records for Brazil and the Brazilian Amazon were presented, showing that the sarcophagid fauna of Amazonian open vegetation types remains poorly known.

Therefore, the goal of this study is to inventory the flesh fly fauna of four Brazilian Amazon savannas in two states (Pará and Amapá), to describe two new species, to present a species redescription, and to provide new data on species distributions.

Material and Methods

Study Areas

The specimens analyzed in this study were collected in four savanna areas from the Brazilian Amazon: 1) municipality of Macapá, state of Amapá (0° 16′09.5″ N 51° 04′08.0″ W) from 14 to 20 June 2019 (Figs. 1A, C, and 2B); 2) municipality of Salvaterra, Marajó Island, state of Pará (0° 48′48.6″ S 48° 36′25.5″ W) from 24 to 30 August 2019 (Figs. 1A, D, and 2A); 3) natural reserve Parque Estadual Serra dos Martírios/Serra das Andorinhas, municipality of São Geraldo do Araguaia, state of Pará (6° 13′32.4″ S 48° 27′56.7″ W) from 20 to 26 October 2019 (Figs. 1A, E, and 2C); 4) municipality of Monte Alegre, state of Pará (2° 00′33″ S 54° 07′05″ W) from 21 to 26 November 2019 (Figs. 1A–B, and 2D).

The map of the study areas was made using the software Quantum Gis version 2.18 (Fig. 1A–E). The aerial images of sampled areas were taken with a DJI Phantom 4 drone, except the satellite image of the Monte Alegre area.

According to the classification proposed by Amaral et al. (2019), the type of savanna present in localities 1 and 2 is the 'park savanna' and in localities 3 and 4 is the 'wooded savanna'. The park savanna is characterized by the presence of clusters of woody and low trees and shrubs that are spaced in the midst of a continuous herbaceous stratum (Fig. 2A and B) (Amaral et al. 2019). The dominant trees in these areas are *Anacardium occidentale*, *Curatella americana*, *Hancornia speciosa*, *Humiria balsamifera*, *Ouratea hexasperma*, *Palicourea rigida*, and *Salvertia convallariodora* (Amaral et al. 2019).

In the wooded savannas of areas 3 and 4, predominates a woody stratum with trees and shrubs ranging in height from 3 to 5 m, forming an agglomerate of trees with about the same height, without defined vertical stratification (Fig. 2C and D) (Amaral et al. 2019). In addition, these two areas have remarkable rocky outcrops. The dominant trees in locality 3 are *Bowdichia virgilioides*, *Dimorphandra mollis*, *Ouratea discophora*, *Rourea induta*, and *Vochysia rufa*; and in locality 4, these are *Loudetiopsis chrysothrix*, *Norantea guianensis*, *Syagrus comosa*, *Vellozia glochidea*, and *Vochysia haenkeana* (Amaral et al. 2019, Devecchi et al. 2020, Ferreira et al. 2021).

Trapping Methods

The specimens were collected with Van Someren-Rydon traps (Fig. 1H) baited with a mixture of ripe hand mashed banana soaked with beer and fermented for 24 h; 'bottle traps' (Fig. 1I) made of 2-liter plastic bottles similar to those used by Amat (2010), but without alcohol, baited with small pieces (about 50 g) of cow lung left to rot for 24h; yellow pan traps (Fig. 1G) were placed on the ground with a mixture of dish detergent, salt, and water; Malaise traps (Fig. 1F) filled with preserving liquid (70% alcohol). Bottle traps and Van Someren-Rydon traps were tied to the tree trunks about 1.50 m from the ground.

Collections were made in four 500 m long transects (transects A to D), at least 500 m apart in the four sites. In transects A and C three Malaise traps were installed 250 m apart from each other for four days, plus ten yellow pan traps 50 m away from each other for 4 d of exposure, where the insects were removed every 24 h, and five Van-Someren Rydon traps distant 100 m from each other for 48 h. In transects B and D five pairs of bottle traps (Fig. 1I) were installed at every 100 m for 48 h.

Specimens captured with Malaise traps, Van Someren-Rydon traps, and yellow pan traps were initially stored in 70% alcohol and specimens collected in bottle traps were stored in paper towel envelopes maintained in a humidifier. Posteriorly, the male specimens were pinned, and the female specimens were stored dry on cotton or in glass vials with 70% alcohol. Only the males were identified at a specific level. All the specimens are deposited in the entomological collection of the Museu Paraense Emílio Goeldi (MPEG), Belém, Pará, Brazil and the Instituto de Pesquisa da Amazônia (INPA), Manaus, Amazonas, Brazil.

Specimen Preparation and Identification

In the study of male terminalia, the terminal portion of the abdomen of some specimens was removed using forceps and entomological pins from specimens relaxed in a humidifier or while they still were stored in alcohol. The terminal portion of the abdomen was macerated in 10% KOH at room temperature for 24 to 48 h, then rinsed in distilled water and diluted 20% acetic acid, and dissected in glycerol. Then, the terminalia was separated from the abdomen and mounted on temporary slides with glycerin.

Drawings of terminalia were made with a drawing tube attached to a Leica DM1000 transmitted light microscope. Specimen photographs at different focal points were taken using a Leica DFC295 digital camera attached to a Leica MZ16 stereomicroscope and subsequently combined into a serial montage image using Helicon Focus 8. Drawings and photographs were processed using Adobe Photoshop and Inkscape. After examination and illustration, terminalia were placed in glass genitalia microvials mounted on the pin beneath the source specimen.

Terminology follows Cumming and Wood (2017) for external morphology and Pape (1987)Buenaventura and Pape (2017), and Mulieri et al. (2016) for male terminalia. The new species were identified to the genus level following the definitions of Buenaventura and Pape (2017).

Format of Inventory

The species list with valid species name with author and year of publication and abundance obtained in the four sampled Brazilian Amazon savannas were presented in a table format. Data about distribution and examined material were presented only for the described and redescribed species and species whose distribution was extended. Distributional data were arranged alphabetically with new records marked with an asterisk.

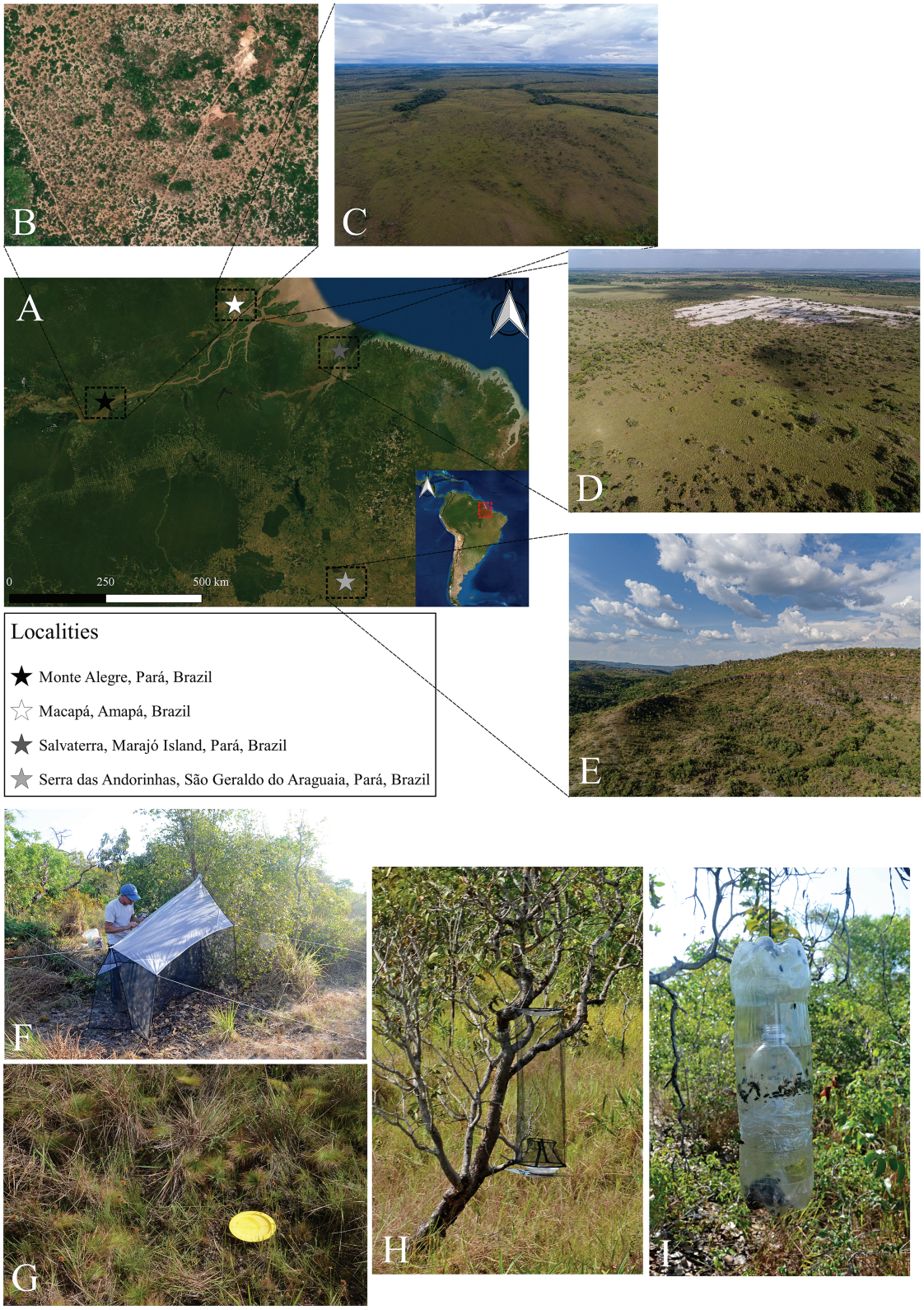

Fig. 1. Study area and traps. (A) Satellite image highlighting the four collecting sites. (B) Satellite image modified from Google Earth of the savanna in Monte Alegre, Pará. (C) Drone image of the savanna in Macapá, Amapá. (D) Drone image of the savanna in Salvaterra, Pará. (E) Drone image of the savanna in Serra das Andorinhas, Pará. (F) Malaise trap. (G) Yellow pan trap. (H) Van Someren-Rydon trap. (I) Bottle trap.

Label data for type-specimens are presented exactly as they appear. Data are listed from the top downward on the staging pin, with lines from each label delimited by a forward slash (/). Information on specimen labels (shape and color) and condition of specimens is provided in square brackets. Data from nontype specimens are presented in the following sequence: country (uppercase), followed

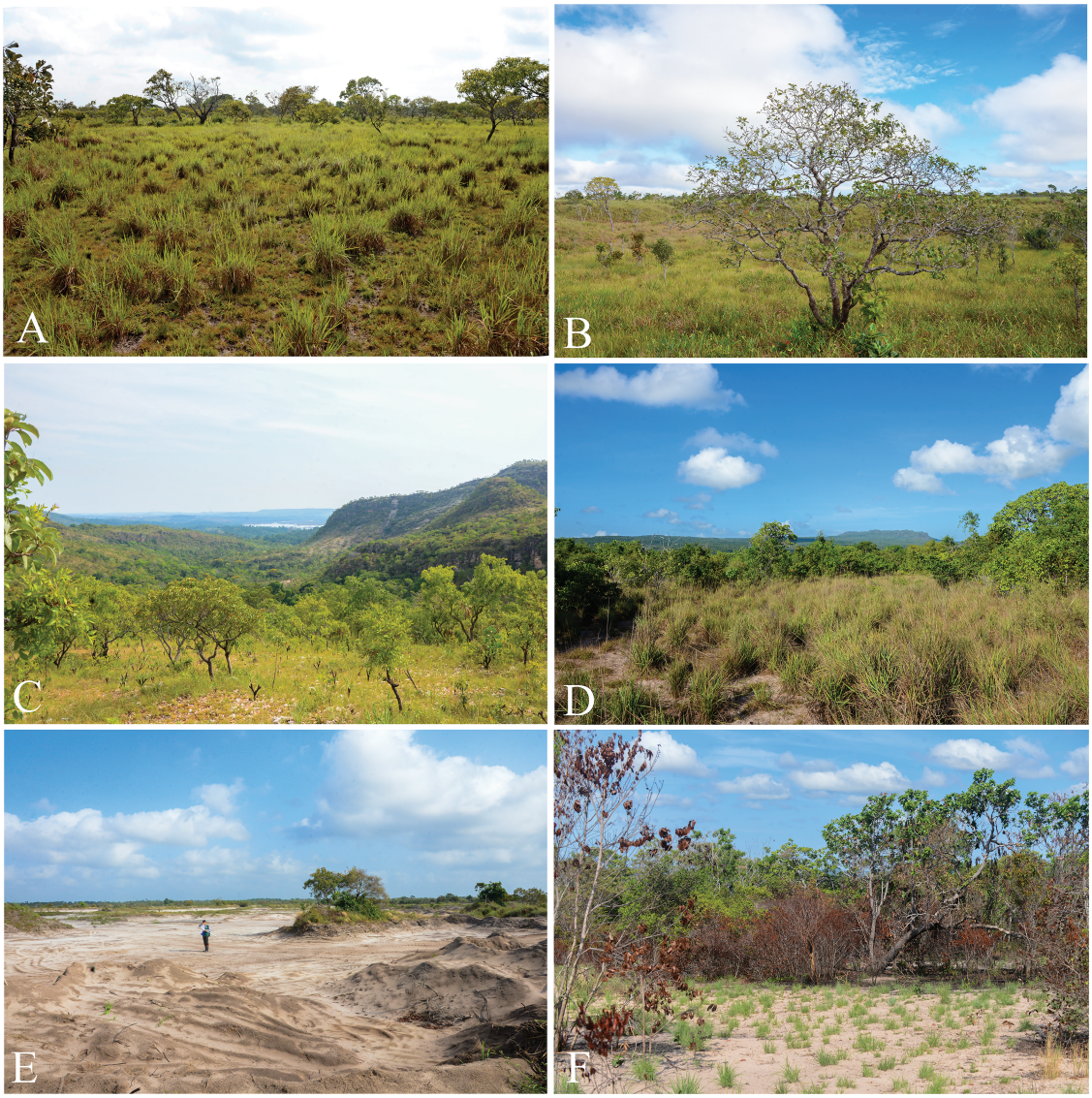

Fig. 2. Overview of Amazonian savannas study area. (A) Salvaterra, Marajó Island, state of Pará. (B) Macapá, state of Amapá. (C) Parque Estadual Serra das Andorinhas, São Geraldo do Araguaia, state of Pará. (D) Monte Alegre, state of Pará. (E) Site utilized for illegal extraction of sand in a savanna area of Salvaterra. (F) Savanna area that was previously buried in Monte Alegre.

by state, province (when present), municipality, geographic coordinate, date of collection, collection method, collector's name, and the number and sex of specimens and institution where the specimens are deposited (in parentheses).

Results

The flesh fly inventory carried out in four Amazonian savannas resulted in 928 male specimens, belonging to 16 genera and 40 species in two subfamilies (Table 1). One of the species is a new record for Brazil, five are new records for the Brazilian Amazon, and two are new to science.

New Species

Lepidodexia (Notochaeta) helenae sp. nov.

Type-material. HOLOTYPE. Male (MPEG) labeled as follows: Brasil [=Brazil], PA [=state of Pará], Marajó/Salvaterra – savana [=savanna]/15–19. VI.2019/Malaise/F. Carvalho-Filho, C. Souza/C. Favacho & R.Barbosa [collectors] [printed on white label]. [Holotype in good condition, with abdomen cleared and stored in microvial with glycerin pinned beneath the specimen] (Fig. 3).

PARATYPES. 7 males (4 MPEG and 3 INPA): same data as holotype. 2 males (MPEG): Brasil [=Brazil], AP [=state of Amapá], Macapá/savana [=savanna], 14–16.VI.2019/ Armad. moscas-pulmão [=bottle trap baited with rotting bovine lung]/F. Carvalho-Filho, C. Souza/ R. Barbosa & C. Favacho [collectors] [printed on white label].

Diagnosis.

Cercal prong pointed apically, and slight bent posteriorly (Fig. 3E). Tip of postgonite dentated (Fig. 3C). Juxta widened, parallel to paraphallus, with a tiny point distally (Fig. 3G). Base of vesica with two membranous well-developed proximal lobes, one of them spinous apically (Fig. 3G).

Description.

Male. Body length: 5.3–5.8 mm (n = 10).

Table 1. Species of Sarcophagidae and abundance of male specimens sampled in four Amazonian savannas, highlighting significant forensic species

Subfamily	Species/localities	Macapá	Monte Alegre	Salvaterra	Serra das Andorinhas	Total	Forensically important	References
Miltogramminae	*Senotainia* sp.			3		3		
Sarcophaginae	*Argoravinia alvarengai* Lopes, 1976			1		1		
	Argoravinia catiae Carvalho-Filho and Esposito, 2012				4	4		
	Dexosarcophaga ampullula (Engel, 1931)				1	1	X	Alves et al. (2014)
	Dexosarcophaga campina Carvalho-Filho et al. 2018			1		1		
	Dexosarcophaga carvalhoi (Lopes, 1980)	1		1	2	4	X	Alves et al. (2014)
	Dexosarcophagapaulistana (Lopes, 1982)	1				1	X	Alves et al. (2014)
	Helicobia biplagiata Dodge, 1966			1		1		
	Helicobia cearensis Tibana, 1976		1			1		
	Lepidodexia (*Notochaeta*) *helenae* sp. nov.	2		8		10		
	Lipoptilocnema augustoi sp. nov.		3			3		
	Malacophagomyia filamenta (Dodge, 1964)		1			1		Mello-Patiu et al. (2014)
	Nephochaetopteryx orbitalis Curran and Walley, 1934				1	1		Mello-Patiu et al. (2014)
	Oxysarcodexia amorosa (Schiner, 1868)		2		41	43	X	Alves et al. (2014)
	Oxysarcodexia angrensis (Lopes, 1933)				1	1	X	Alves et al. (2014)
	Oxysarcodexia carvalhoi Lopes, 1946		6	1	1	8	X	Alves et al. (2014)
	Oxysarcodexia diana (Lopes, 1933)				1	1	X	Alves et al. (2014)
	Oxysarcodexia fluminensis Lopes, 1946	1				1	X	Alves et al. (2014)
	Oxysarcodexia fringidea (Curran and Walley, 1934)		2	6		8	X	Bitar et al. (2013)
	Oxysarcodexia graminifolia Souza et al. 2020		1			1		
	Oxysarcodexia intona (Curran and Walley, 1934)		62	114	1	177	X	Alves et al. (2014)
	Oxysarcodexia modesta Lopes, 1946	5		19	4	28	X	Alves et al. (2014)
	Oxysarcodexia nitida Soares and Mello-Patiu, 2010				1	1		
	Oxysarcodexia occulta Lopes, 1946				3	3		
	Oxysarcodexia simplicoides (Lopes, 1933)				2	2	X	Alves et al. (2014)
	Oxysarcodexia thornax (Wiedemann, 1830)		1	12	179	192	X	Alves et al. (2014)
	Oxysarcodexia timida (Aldrich, 1916)		1	5	1	7	X	Alves et al. (2014)
	Oxysarcodexia xanthosoma (Aldrich, 1916)			40	3	43	X	Meira and Barros (2015)
	Oxyvinia excisa (Lopes, 1950)				13	13		Cruz et al. (2021)
	Peckia (*Euboettcheria*) *collusor* (Curran and Walley, 1934)			5	4	9	X	Alves et al. (2014)
	Peckia (*Peckia*) *chrysostoma* (Wiedemann, 1830)	1	19	1		21	X	Alves et al. (2014)

Table 1. Continued

Subfamily	Species/localities	Macapá	Monte Alegre	Salvaterra	Serra das Andorinhas	Total	Forensically important	References
	Peckia (*Peckia*) *pexata* (Wulp, 1895)	26	4	3		33	X	Alves et al. (2014)
	Peckia (*Sarcodexia*) *lambens* (Wiedemann, 1830)	3	5		8	16	X	Alves et al. (2014)
	Peckia (*Squamatodes*) *trivittata* (Curran, 1927)	1	2		1	4	X	Alves et al. (2014)
	Ravinia belforti (Prado and Fonseca, 1932)			1	21	22	X	Alves et al. (2014)
	Ravinia effrenata (Walker, 1861)				4	4	X	Alves et al. (2014)
	Retrocitomyia retrocita (Hall, 1933)			26	3	29		
	Titanogrypa (*Cucullomyia*) *larvicida* (Lopes, 1935)				2	2	X	Alves et al. (2014)
	Tricharaea (*Sarcophagula*) *occidua* (Fabricius, 1794)		13	66	128	207	X	Alves et al. (2014)
	Villegasia almeidai Lopes, 1938		20			20	X	Ortloff et al. (2012)
Total		**41**	**143**	**314**	**430**	**928**		

These specimens are pinned and deposited in Museu Paraense Emílio Goeldi (MPEG) and Instituto Nacional de Pesquisas da Amazônia (INPA).

Head.
Parafacial and fronto-orbital plates with golden microtomentum. Parafacial plate with row of fine and short setulae close to eye. Frontal vitta brown with a row of 7–8 frontal setae. Reclinate orbital setae absent. Inner vertical setae fine and parallel. Outer vertical seta differentiated from postocular setae and shorter than inner vertical seta. Ocellar triangle black with grayish microtomentum, with one pair of proclinate and parallel or slightly divergent fine ocellar setae. Postocular area with silvery microtomentum. Genal groove and genal dilation with golden microtomentum. Postgena with silvery microtomentum. Gena and postgena with black setae. Antenna light brown, flagellomere 1 with whitish microtomentum, arista plumose on basal half. Palpus slight clubbed, light brown with black setae.

Thorax.
Black; prescutum and scutum with dorsal and lateral stripes of greyish microtomentum and three black stripes; postpronotal lobe, proepisternum, notopleuron, anepisternum, katepisternum and anepimeron with spots of grey microtomentum (Fig. 3A). *Chaetotaxy*: acrostichal 0 + 1, dorsocentral 2 + 3, intra-alar 1 + 2, supra-alar 1 + 3, postpronotal 3, postalar 2, notopleural 2 (with 1 to 2 subprimary notopleural), proepisternum setulose; proepisternal setae 1; proepimeral setae 1 without supplementary setae, katepisternal 3 (the middle smaller), meral 4, postalar wall bare, scutellum with three pairs of lateral scutellar setae and 1 apical sucutellar seta. Wing hyaline, tegula blackish, whitish basicosta, and brown veins, R_1 bare in dorsal view, R_{4+5} setulose dorsally in the proximal half of distance to r-m, costal spine not differentiated, third costal sector with ventral setae, cell r_{4+5} open, lower calypter whitish, with a yellowish rim. Legs with coxa, trochanter, and femur blackish with silvery-gray microtomentum, tibiae dark brown; fore femur with a row of long and fine setae dorsally and ventrally; fore tibia with 2 anterodorsal setae on basal half, 2 posterodorsal and 1 posteroventral setae on distal half; mid femur with 1 median seta laterally on anterior face and 1 anteroventral seta on basal half, 2 posteroventral setae on basal half, 2 preapical on the upper half and a row of fine setae ventrally on apical margin; mid tibia with 1 anterodorsal and 1 anteroventral seta on distal half and two posterodorsal setae; hind femur with 2 anteroventral setae and 1 anterodorsal seta; hind tibia with 2 anterodorsal and 2 posterodorsal setae; tarsi brown.

Abdomen.
Tergites dark brown in ground color. Tergites 1 + 2 to 5 with yellowish-grey microtomentum (Fig. 3A). Tergite 1 + 2 with one pair of lateral marginal setae. Tergite 3 with one pair of lateral marginal setae and one pair of median marginal setae. Tergite 4 with a row of marginal setae (3 pairs). Tergite 5 with a complete row of marginal setae. *Terminalia*. Sternite 5 V-shaped, light brown, wider than long, with deep cleft almost reaching anterior margin; arms broadened, divergent and rounded distally, covered with long setae; base short with a median membranous window (Fig. 3B). Syntergosternite 7 + 8 and epandrium dark brown with yellowish-gray microtomentum. Cerci blackish, with broadened cercal base covered with long and fine setae and minute setulae. Cercal prong narrowed and slightly bent anteriorly, with a pointed tip curved posteriorly, without setulae, and with some short fine setae (Fig. 3E and F). Cercal base laterally expanded in posterior view (Fig. 3D). Cercal prongs spaced and parallel in posterior view (Fig. 3D). Surstylus triangular, with some fine setulae, and a cluster of setulae on posterobasal corner (Fig. 3E and F). Pregonite with broadened base and narrowed distal portion strongly curved anteriorly, with a pointed tip and some tiny setae on basal half (Fig. 3C). Postgonite elongate and thin, with distal half strongly curved anteriorly, with a very long seta on anterior margin and dentated tip (Fig. 3C). Phallus dark brown, arched, with connection between basiphallus and distiphallus as an evident hinge (Fig. 3G). Basiphallus elongate and narrowed, strongly arched (Fig. 3G). Paraphallus broadened, with grooves on ventral surface (Fig. 3G). Juxta broadened and sclerotized, pointed apically, parallel to paraphallus (Fig. 3G). Harpes sclerotized, elongated, and narrowed, tapering distally (Fig. 3G). Vesica, in lateral view, narrowed and elongate, slightly arched (Fig. 3G); composed of one broadened plate (Fig. 3H) with two developed membranous proximal lobes, one of

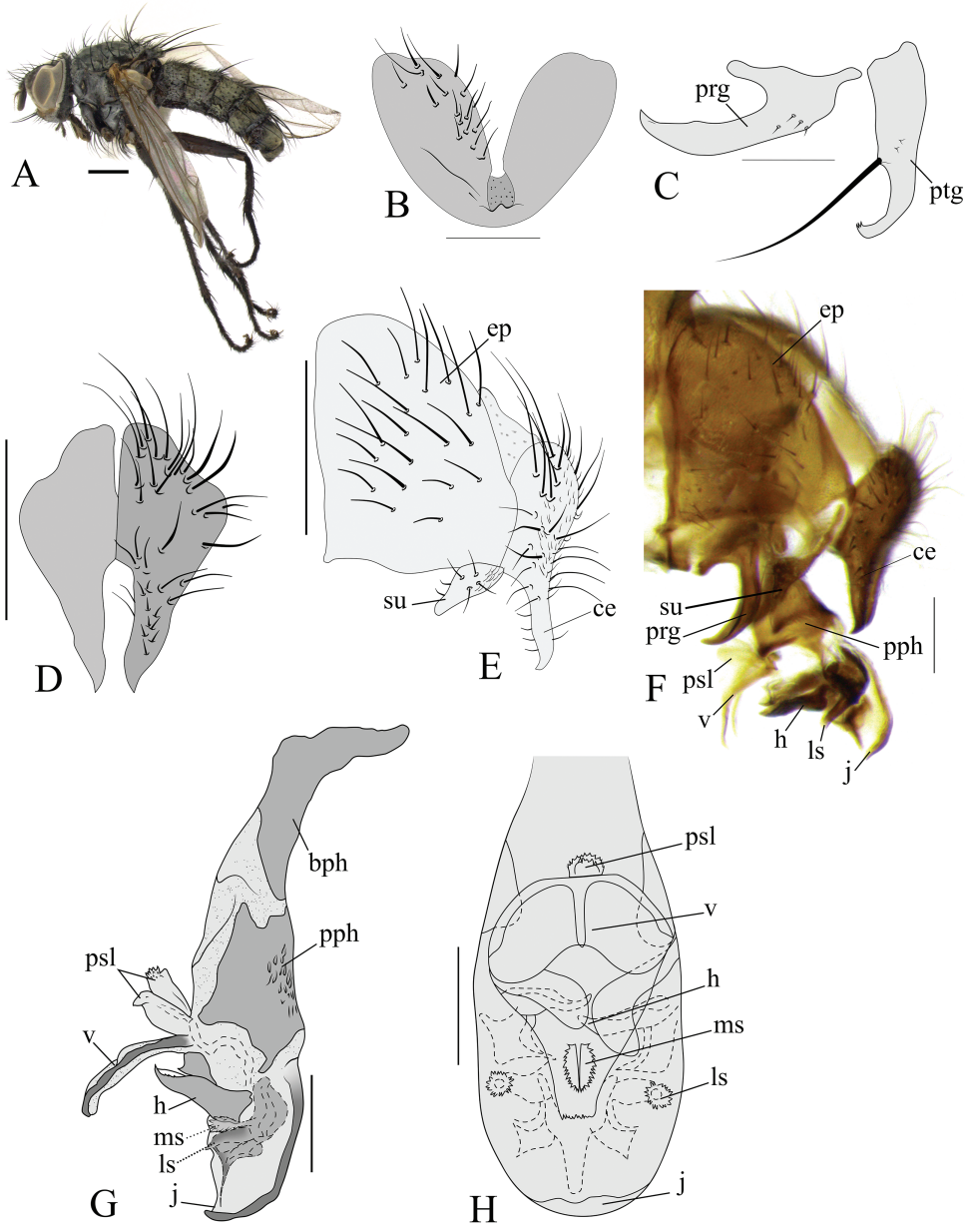

Fig. 3. *Lepidodexia* (*Notochaeta*) *helenae* sp. nov., male paratype. (A) Habitus, left lateral view; scale bar: 1.0 mm. (B) Sternite 5, ventral view (setation omitted on the right side); scale bar: 500 µm. (C) Gonites, left lateral view; scale bar: 100 µm. (D) Cerci, posterior view (setation omitted on the left side); scale bar: 250 µm. (E) Epandrium, surstylus, and cercus, left lateral view; scale bar: 250 µm. (F) Terminalia, left lateral view; scale bar: 0.2 mm. (G) Phallus, lateral view; scale bar: 100 µm. (H) Distiphallus, lateral view; scale bar: 100 µm. Abbreviations: bph = basiphallus; c = capitis; ce = cercus; ep = epandrium; h = harpes; j = juxta; ls = lateral stylus; ms = median stylus; pph = paraphallus; prg = pregonite; psl = proximal spinous lobe of vesica; ptg = postgonite; su = surstylus; ve = vesica. Scale bars: 0.1 mm.

them spinous distally (Fig. 3G). Lateral stylus tubular and pointed distally, bearing minute spines (Fig. 3G and H). Median stylus clavate and barbed distally (Fig. 3G and H).

Female.
Unknown.

Remarks.
This species runs to *Lepidodexia* (*Notochaeta*) *ignota* (Lopes, 1947) in the key by Lopes (1985), from which differs in having cercus with a pointed tip curved anteriorly; vesica nonclubbed apically; juxta widened, non-hooked apically. In *L. ignota* the tip of the cercus is rounded and almost straight; the vesica is clubbed apically and the juxta is narrowed, with a hooked tip (see Fig. 30 in Lopes (1985)).

Most of the species of subgenus *Notochaeta* with developed vesica, have the tip of this structure clubbed, a feature not present in the new species (Fig. 3G and H). This morphological condition is shared with *Lepidodexia* (*Notochaeta*) *cyaneiventris* (Lopes, 1946) (see Fig. 66 in Lopes (1946)), which has vesica strongly arched, lacking proximal spinous lobe and juxta almost perpendicular to paraphallus. In *L.* (*Notochaeta*) *helenae* sp. nov. the vesica is slightly arched, bearing a prominent proximal spinous lobe, and the juxta is parallel to the phallic tube (Fig. 3G).

Distribution.
NEOTROPICAL—Brazil (Amapá, Pará).

Etymology.
The name of this species honors the Brazilian educator Helena do Socorro Alves Quadros (MPEG), who actively and tirelessly worked in scientific divulgation in the MPEG for four decades. She created the project Museu Goeldi de Portas Abertas (The Goeldi Museum with opened doors) in the 80s, which allowed the community, mostly from public schools, to visit and learn about the scientific collections and research that was being conducted by Goeldi Museum researchers. She brought science to people, and the entomology department always participated in this project. She was a true friend, always with a big smile and with a fearless desire to give to everyone, from kids to old people, access to knowledge. She passed away in April 2021. The species name is a noun in the genitive case.

Key to the Identification of Males of the Subgenera *Notochaeta* and *Euflettcherimyia* of *Lepidodexia*

The new species runs to couplet 36 of the key by Lopes (1985), and can be identified based on the following added couplet (36a):

36. Ocellar seta with about the same length of frontal seta. Proximal lobe of vesica without cuticular spines … *Lepidodexia* (*Notochaeta*) *similis* Lopes

– Ocellar seta shorter than frontal seta. Proximal lobe of vesica with cuticular spines … 36a

36a. Cercus with pointed tip curved anteriorly (Fig. 3E). Vesica nonclubbed apically (Fig. 3G and H). Juxta widened, nonhooked apically (Fig. 3G) … *Lepidodexia* (*Notochaeta*) *helenae* sp. nov.

– Cercus with rounded tip almost straight. Vesica clubbed apically. Juxta narrowed, hooked apically … *Lepidodexia* (*Notochaeta*) *ignota* Lopes.

Lipoptilocnema augustoi **sp. nov.**
Type-material. HOLOTYPE. Male (MPEG) labeled as follow: Brasil [=Brazil], PA [=state of Pará], Monte Alegre/2° 00′33″ S 54° 07′05″ W/savana [=savanna]/prato amarelo [=yellow pan trap]/24–25. XI.2019/F. Carvalho-Filho, S.L. Camargo/D. Guimarães & A. Quaresma [collectors] [printed on white label]. [Holotype in good condition, lacking right wing and with abdomen cleared and stored in microvial with glycerin pinned beneath the specimen] (Fig. 4).

PARATYPES. 2 males (MPEG): same data as holotype.

Diagnosis.
Median apophysis of sternite 5 of male asymmetrically bifid. Vesica wavy and with microserration. Median stylus boot-shaped.

Description.
Male. Body length: 9.1–9.2 mm (n = 3).

Head.
Parafacial and fronto-orbital plates with golden microtomentum. Parafacial plate with a row of fine setulae close to the eye. Fronto-orbital plate with sparse black setulae. Postcranium with silvery microtomentum, with 2 rows of black occipital setae on the upper part, parallel to postorbital setae, and with pale setae below. Frontal vitta black with 7–9 frontal setae. Orbital reclinate setae present. Inner vertical setae thick and reclinate. Ocellar triangle black, with one pair of small proclinate and divergent ocellar setae. Postocellar and paravertical setae present. Postocular area with golden microtomentum. Genal groove, genal dilation, and postgena with golden microtomentum. Gena with black setae and postgena with pale setae. Antenna brown, flagellomere 1 brown with grey microtomentum. Arista long plumose on basal three-fourth. Palpus brown with black setulae.

Thorax.
Black, with silvery-grey microtomentum; prescutum and scutum with dorsal and lateral stripes of grey microtomentum; postpronotal lobe, proepisternum, notopleuron, anepimeron, and katepisternum with grey microtomentum; anepisternum with yellowish microtomentum. *Chaetotaxy*: acrostichal 0 + 1, dorsocentral 2 + 3, intra-alar 1 + 2, supra-alar 2 + 3 (the middle thicker), postpronotal 2, postalar 2, notopleural 4 (2 strong primary setae and 2 short subprimary setae), anepisternal 6, katepisternal 3, meral 8, scutellum with 2 pairs of lateral scutellar setae and 1 pair of crossed apical scutellar setae. Wing hyaline, tegula black, yellowish basicosta, and brown veins, R_1 bare, R_{4+5} setulose in proximal half of distance to r-m, costal spine not differentiated, third costal sector without ventral setae, cell r_{4+5} open at wing apex, lower calypter whitish. Legs with coxae, and femora black with silvery microtomentum; trochanters and tibia brown; fore femur with a row of long setae ventrally and with a row dorsally on distal half; fore tibia with 1 anteroventral seta on distal half and 1 posterodorsal seta on basal half; mid femur with a row of median setae and a row of long setae ventrally on anterior face and two posterodosal preapical setae; fore tibia with 1 anterodorsal seta and 1 posterodorsal seta on basal half; hind femur with a row of short anterodorsal setae; hind tibia with 3 anterodorsal setae and 3 posterodorsal setae.

Abdomen.
Tergites dark brown in ground color. Tergites 1 + 2 to 5 with dorsal and lateral spots of silvery microtomentum. Tergite 1 + 2 to tergite 4 each with one pair of lateral marginal setae. Tergite 4 with median marginal setae. Tergite 5 with a complete row of marginal setae. Sternites 1–4 black with silvery microtomentum. Sternites 1–4 covered with long setae. *Terminalia*. Sternite 5 light brown, longer than wide, widened distally, with arms narrowed and rounded apically, region between arms with a triangular hump bearing a median apophysis asymmetrically bifid, covered with fine and hair-like setae (Fig. 4B). Syntergosternite 7 + 8 dark reddish (darker at anterior part) with a spot of silvery microtomentum, with short hair-like setulae, and with a marginal row of four pairs of long and fine setae. Epandrium reddish, with hair-like setae. Cercus elongate and widened laterally, with cercal prong strongly bent postad; cercal base with long and fine setae; cercal prong with some long and fine setae and with some small spine-like distally (Fig. 4E and F). Cercal prongs, in posterior view, widely separated, parallel, and with pointed apex (Fig. 4D). Surstylus widened, with tip rounded and bearing long and fine setae, mainly distally (Fig. 4E and F). Pregonite claw-shaped, shorter than postgonite, with 3 small pointed setae distally on posterior margin (Fig. 4C). Postgonite elongate and curved anteriorly, with pointed tip and with 2 long and 3 short setae on anterior margin (Fig. 4C). Phallus elongate and slight bent (Fig. 4G and H). Basiphallus shorter than distiphallus, widened distally. Paraphallus elongate and almost straight (Fig. 4G and H). Juxta well-developed, about the same length as median stylus, with a well sclerotized medial keel covered with stout spines, and membranous lateral surfaces covered with microtrichia (Fig. 4G and H). Median stylus boot-shaped, membranous with microtrichia on upper and lower surface, covered with tiny pigmented scale-like processes (Fig. 4G and H). Lateral projection of median stylus elongate, narrowed, and sclerotized (Fig. 4H).

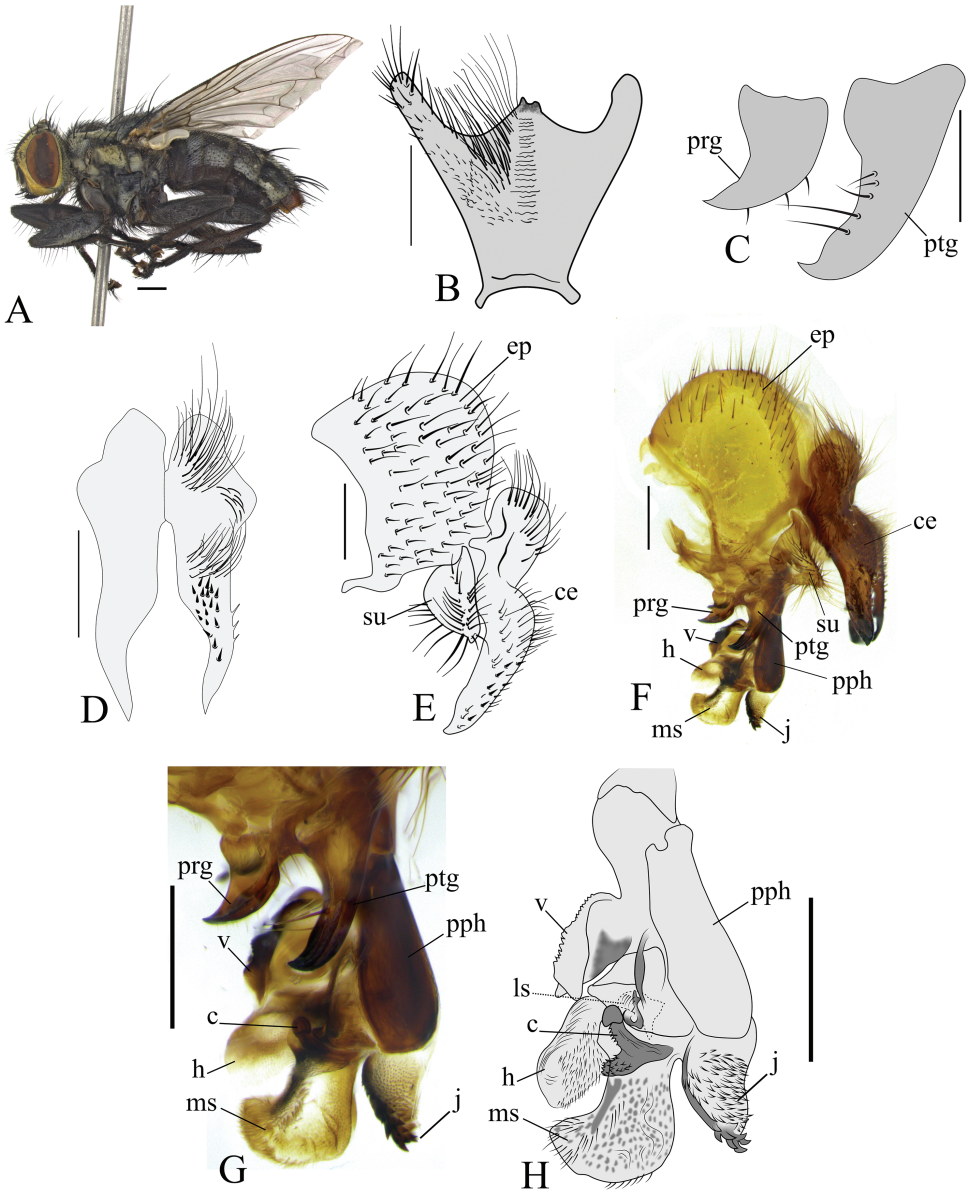

Fig. 4. *Lipoptilocnema augustoi* sp. nov. male paratype. (A) Habitus, left lateral view; scale bar: 1.0 mm. (B) Sternite 5, ventral view (setation omitted on the right side); scale bar: 0.5 mm. (C) Gonites, left lateral view; scale bar: 0.25 mm. (D) Cerci, posterior view (setation omitted on the left side); scale bar: 0.5 mm. (E) Epandrium, surstylus, and cercus, left lateral view; scale bar: 0.5 mm. (F) Terminalia, left lateral view; scale bar: 0.5 mm. (G) Phallus, lateral view; scale bar: 0.5 mm. (H) Distiphallus, posterior view; scale bar: 0.5 mm. Abbreviations: c = capitis; ce = cercus; ep = epandrium; h = harpes; j = juxta; ls = lateral stylus; ms = median stylus; pph = paraphallus; prg = pregonite; ptg = postgonite; su = surstylus; ve = vesica. Scale bars: 0.1 mm.

Harpes glossiform, membranous with microserration (Fig. 4G and H). Vesica sclerotized on margins, wavy, and with microserration (Fig. 4G and H).

Female.
Unknown.

Distribution.
NEOTROPICAL—Brazil (Pará).

Etymology.
The name of this species honors the scientific technician Luís Augusto Quaresma (MPEG), who actively worked in the preservation of the entomological collection of the MPEG, helping the new students of entomology and in fieldwork. Augusto actively worked in scientific dissemination as well, and participated in Professora Helena's project from the very beginning until the last public program, before the pandemic. In addition, the expedition carried out in Monte Alegre (one of the areas sampled in this study) was Augusto's last fieldwork, in which the first author also had the chance to participate. Augusto was an incredible friend, and his absence is felt every day. He passed away in January 2021. The species name is a noun in the genitive case.

Remarks.
Lipoptilocnema augustoi sp. nov. differs from all other species in the genus in having a characteristic boot-shaped media stylus (Fig. 4G and H). In the key published in the taxonomic review of *Lipoptilocnema* by Mulieri et al. (2016), the new species runs to *L. salobrensis* Lopes, from which it differs mainly in the shape of the

phallus. In *L. augustoi* sp. nov. the media stylus is boot-shaped and the juxta is enlarged, almost as long as the median stylus (Fig. 4G and H). In *L. salobrensis* the median stylus is glossiform and the juxta is short, about half of the length of the median stylus (see Fig. 82 in Mulieri et al. (2016)).

Key to the Identification of Males of *Lipoptilocnema*

The new species runs to couplet 9 of the key by Mulieri et al. (2016), which should be replaced by the couplets below:

9. Postcranium with three rows of black occipital setae parallel to postorbitals. ST5 without basal medial hump. Cerci with rounded tip in dorsal view... *Lipoptilocnema tibanae* Mulieri et al. (2016).

– Postcranium with two rows of black occipital setae parallel to postorbitals (sometimes with a few isolated black setae below the second row). ST5 with basal medial hump (Fig. 4B). Cerci with pointed tip in dorsal view (Fig. 4E and F)... 10

10. Pregonite with pointed tip (Fig. 4C). Media stylus boot-shaped (Fig. 4G and H). Juxta enlarged, almost as long as the median stylus (Fig. 4E and F) … *Lipoptilocnema augustoi* sp. nov.

– Pregonite with rounded tip. Media stylus composed of glossiform projections. Juxta short, shorter than the median stylus … *Lipoptilocnema salobrensis* Lopes.

Redescription

Dexosarcophaga paulistana **Lopes (1982) Material examined.**
BRAZIL. Amapá: Macapá, 14–20.VI.2019, fly trap baited with rotting bovine lung, leg. F. Carvalho-Filho, C. Souza, R. Barbosa, and C. Favacho (1 male, MPEG) (Fig. 5).

Diagnosis.
Wing vein R_1 bare. Vesica T-shaped, with distal portion hook-shaped laterally and bifid; bearing some small spine-like projections in the portion parallel to distiphallus (Fig. 5E and F).

Description.
Male. Body length: 4.7 mm (n = 1).

Head.
Fronto-orbital and parafacial plates covered with silver microtomentum. Parafacial plate with setulae sparsely distributed along inner eye margin. Frontal vitta dark-brown, with a row of 6 frontal setae. One reclinate fronto-orbital seta. Proclinate fronto-orbital setae absent. Outer vertical setae not differentiated from postocular setae. Gena and postgena with silver microtomentum and black setae. Antenna brown, arista long plumose on basal 2/3. Palpus black.

Thorax.
Chaetotaxy: acrostichal 0 + 1, dorsocentral 2 + 2, intra-alar 2 + 2 (anterior one shorter), supra-alar 2 + 3, postpronotal 3, postalar 2, notopleural 4 (2 strong primary setae and 2 short subprimary setae), anepisternal 6, katepisternal 3, scutellum with 1 pair of basal setae, 1 pair of lateral setae, no apical setae and 1 pair of discal setae. Legs. Black. Mid femur with a ctenidium of rounded spines on posteroventral surface. Mid tibia with 1 median seta on ventral surface and 2 median setae on posterodorsal surface. Hind tibia with 1 median anteroventral seta. Wing. Hyaline. Costal spine absent. Vein R_1 bare. Third costal section bare ventrally.

Abdomen.
Tergites dark brown in ground color. Tergites 3 to 5 with a band of silvery-grey microtomentum on anterior 4/5 on dorsal and lateral surfaces. Syntergite 1 + 2 without median marginal setae. Tergites 3 and 4 with a pair of median marginal setae. Tergite 5 with a complete row of marginal setae. Sternites 2–4 dark brown, with long, black, hair-like setae. *Terminalia*. Sternite 5 V-shaped, posterior arms slender, with setae in the posterior region. Syntergosternite 7 + 8, epandrium and cercus black. Cercus shorter than epandrium, slightly curved ventrally in lateral view, with pointed apex, and long setae restricted to cercal base (Fig. 5D and E). Cercal base expanded laterally, in posterior view (Fig. 5C). Cercal prongs parallel with divergent tips (Fig. 5C). Surstylus widened, tapering distally with a long apical seta and some thick setae on distal half (Fig. 5D and E). Pregonite elongate, slightly shorter than postgonite, curved ventrally, with pointed apex (Fig. 5B). Postgonite elongate, with tip curved ventrally and with a long seta and some small spine-like setae distally on anterior margin (Fig. 5B). Phallus light brown, with membranous area between basi- and distiphallus (Fig. 5F). Basiphallus elongate, longer than wide, curved posteriorly (Fig. 5F). Distiphallus with posterior margin bearing a membranous glossiform plate (Fig. 5F). Juxta short and pointed (Fig. 5E and F). Vesica sclerotized, T-shaped, with tip hook-shaped laterally; bearing some small spine-like projections in the portion parallel to distiphallus (Fig. 5E and F). Vesica, in ventral view, widened with bifid distal portion. Lateral and median styli short and tubular; lateral stylus with small spines (Fig. 5F).

Female.
Unknown.

Distribution.
NEOTROPICAL. Brazil (Distrito Federal, Minas Gerais, Amapá*, São Paulo).

Remarks.
This species was described by Lopes (1982) based on a male specimen from São Paulo, Brazil. The figures of the phallus in the original description are not detailed, and do not highlight the diagnostic features, such as the bifid tip of the vesica. Therefore, we decided to redescribe this species, and the utilized specimen for this was compared to a photograph taken of a male specimen from MNRJ (Museu Nacional do Rio de Janeiro) identified as *D. paulistana* by Ms. Josenilson Santos and Dr. Cátia Mello-Patiu.

Dexosarcophaga paulistana is similar to *Dexosarcophaga varia* (Dodge, 1968) (see redescription in Mello (1996)) in having T-shaped vesica, but it differs from *D. varia* in having tip of vesica hook-shaped and bearing some stout spine-like projections laterally and juxta short and pointed. In *D. varia* the tip of vesica is rounded and it lacks spine-like projections laterally and the juxta is well-developed and rounded distally. In addition, the vesica of *D. varia* has many tiny cuticular spine-like projections on the base (see Figs. 39 and 44 in Mello (1996)), that are absent in *D. paulistana*.

Notes on distribution.
This species is newly recorded from the Brazilian Amazon since it has previously been recorded only for southern Brazil (São Paulo and savannas of Minas Gerais) (Pape 1996, Rosa et al. 2011, Mello-Patiu et al. 2014, Faria et al. 2017, Paseto et al. 2019), and in the savanna of Central Brazil (Distrito Federal) (Barros et al. 2008).

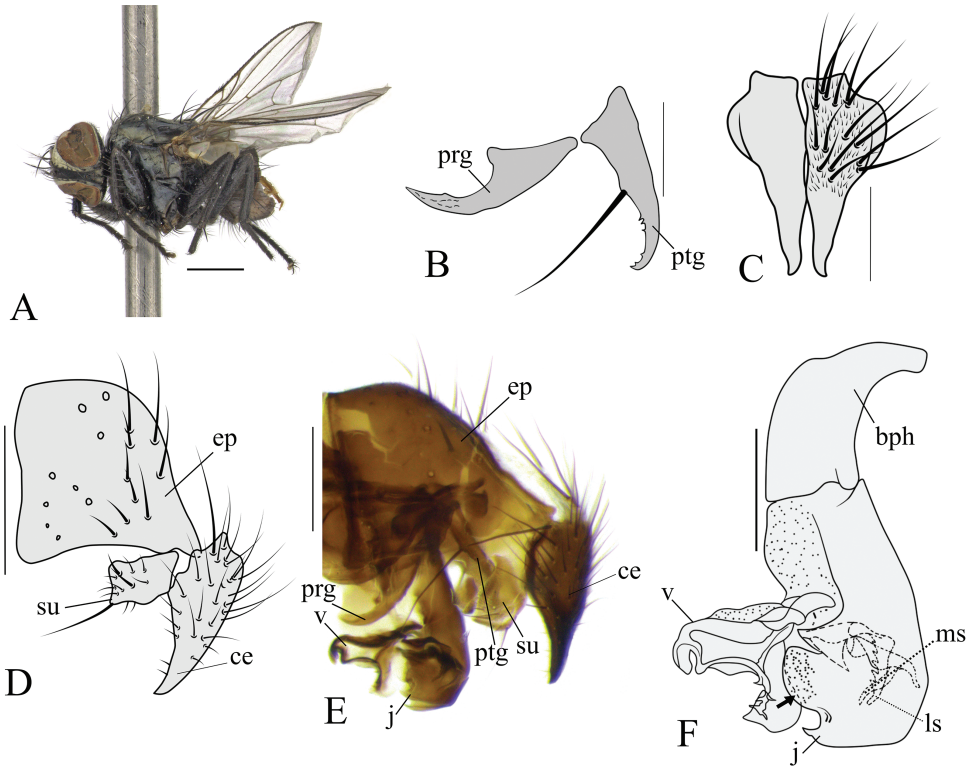

Fig. 5. *Dexosarcophaga paulistana* Lopes (1982), male specimen. (A) Habitus, left lateral view; scale bar: 1.0 mm. (B) Gonites, left lateral view; scale bar: 100 µm. (C) Cercus, posterior view (setation omitted on the left side); scale bar: 100 µm. (D) Epandrium, surstylus, and cercus, left lateral view; scale bar: 250 mm. (E) Terminalia, left lateral view; scale bar: 0.2 mm. (F) Phallus, lateral view; black arrow showing glossiform plate; scale bar: 5.0 mm. Abbreviations: ce = cercus; ep = epandrium; j = juxta; ls = lateral stylus; ms = median stylus; prg = pregonite; ptg = postgonite; su = surstylus; ve = vesica.

New Records

Helicobia biplagiata **Dodge, 1966** **Material examined.**
BRAZIL.Pará:Marajó Island, Salvaterra, 0°48'48.6"S 48°36'25.5"W, 15–19.VI.2019, savanna, yellow pan trap, leg. F. Carvalho-Filho, R. Barbosa, C. Favacho, and C. Souza (1 male, MPEG).

Notes on distribution.
This species is widely distributed in South America, but in Brazil it has been recorded only for the states of Rio de Janeiro (Pape 1996; Mello-Patiu et al. 2009). The new record represents the first report for the Brazilian Amazon.

Distribution.
NEOTROPICAL – Brazil (Pará*, Rio de Janeiro), Chile, Ecuador, Peru.

Helicobia cearensis Tibana, 1976 **Material examined.**
BRAZIL. Par.: Monte Alegre, 2° 00.33. S 54° 07.05. W, 24–25. XI.2019, savanna, yellow pan trap, leg. F. Carvalho-Filho, S.L. Camargo, D. Guimarães, and A. Quaresma (1 male, MPEG).

Notes on distribution.
This species has been recorded only from northern Brazil (Pape 1996), and the new record represents a new report for the Brazilian Amazon.

Distribution.
NEOTROPICAL—Brazil (Ceará, Bahia, Pará*).

Oxysarcodexia graminifolia Souza et al. 2020 **Material examined.**
BRAZIL. Par.: Monte Alegre, 2° 00.33. S 54° 07.05. W, 24–25. XI.2019, savanna, yellow pan trap, leg. F. Carvalho-Filho, S.L. Camargo, D. Guimarães, and A. Quaresma (1 male, MPEG).

Notes on distribution.
Oxysarcodexia graminifolia was recently described by Souza et al. (2020) based on specimens from Ecuador and Colombia. Therefore, this is the first record of this species for Brazil. This species is widely distributed in the Brazilian Amazon since it has been collected in white sand vegetation (treated as *Oxysarcodexia* sp. in Carvalho-Filho et al. (2018)), tropical rain forests (upland and flooded forests), and mangrove forests (in preparation).

Distribution.
Brazil (Pará*), Colombia, Ecuador.

Oxysarcodexia nitida Soares and Mello-Patiu, 2010 **Material examined.**
BRAZIL. Pará: Parque Estadual Serra dos Martírios/Serra das Andorinhas, 6° 13.32.4. S 48° 27.56.7. W, 20–26.X.2019, savanna, fly trap baited with rotting bovine lung, leg. F. Carvalho-Filho, C. Favacho, J. M. M. Soares, and C. Souza (1 male, MPEG).

Comments.
This species was first recorded for the Brazilian Amazon by Carvalho-Filho et al. (2017) but only for the state of Amazonas. Thus, this is the first record for the state of Pará.

Distribution.
Brazil (Amazonas, Mato Grosso, Mato Grosso do Sul, Pará*), Ecuador, Peru.

Oxysarcodexia simplicoides (**Lopes, 1933**) **Material examined.**
BRAZIL. Pará: Parque Estadual Serra dos Martírios/Serra das Andorinhas, 6° 13.32.4. S 48° 27.56.7. W, 20–26.X.2019, savanna, fly trap baited with rotting bovine lung, leg. F. Carvalho-Filho, C. Favacho, J. M. M. Soares, and C. Souza (2 males, MPEG).

Comments.
This species has been recording in several states of Brazil (Souza et al. 2020), but this is the first record for the Brazilian Amazon.

Distribution.
NEOTROPICAL. Brazil (Ceará, Espírito Santo, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará*, Rio de Janeiro).

Oxyvinia excisa (**Lopes, 1950**) **Material examined.**
BRAZIL. Par.: Parque Estadual Serra dos Mart.rios/Serra das Andorinhas, 6° 13.32.4. S 48° 27.56.7. W, 20–26.X.2019, savanna, fly trap baited with rotting bovine lung, leg. F. Carvalho-Filho, C. Favacho, J. M. M. Soares, and C. Souza (13 males, MPEG).

Comments.
This species has been recorded from Argentina, Brazil, Colombia, and Peru (Pape 1996, Dufek et al. 2015, Valverde-Castro et al. 2017), but this is the first record from the Brazilian Amazon.

Distribution.
NEOTROPICAL. Argentina, Brazil (Goiás, Rio de Janeiro, Minas Gerais, Pará*), Colombia, Peru.

Discussion

Sarcophagidae comprises three subfamilies: Paramacronychiinae, Miltogramminae, and Sarcophaginae, but only the last two occur in Brazil (Pape 1996, Yan et al. 2020). Most Brazilian species belong to Sarcophaginae and this is true in the Brazilian Amazon as well, where only seven species of Miltogramminae have been recorded (Carvalho-Filho et al. 2018). Only one species of Miltogramminae of the genus *Senotainia* Macquart, 1846 (Fig. 6) was collected in one of the four sampled savannas (Table 1). We dissected the male genitalia of one of these specimens (Fig. 6B and C), and it belongs to the same species found in the white-sand enclaves by Carvalho-Filho et al. (2018). They were not identified to a specific level, because the Neotropical species of *Senotainia* were not well characterized, hampering an accurate species determination.

The nature of the data obtained with the sampling protocol utilized in this study does not allow us to determine what species are restricted to Amazonian savannas. However, based on comparisons with species lists of flesh fly inventories performed in Amazonian forested areas and in other biomes (Amat 2010, Sousa et al. 2011, 2016; Barbosa et al. 2015, 2017; Vasconcelos et al. 2015, Dufek et al. 2016), it is possible to assess that most of the specimens collected in the Amazonian savannas are widely distributed.

The genus *Lipoptilocnema* is restricted to the eastern portion of South America and, in Brazil, it has been found mainly in *cerrado* (savanna from Central Brazil) and Atlantic Forest biomes (Mulieri et al. 2016). Specimens of this genus are uncommon in the Brazilian Amazon and the few collected specimens of known species have been found in highly anthropized areas (personal observations), suggesting that they are expanding their range following the expansion of deforestation. This is not the case for *Lipoptilocnema augustoi* sp. nov., which, unlike the other species in the region, have been found only in the isolated patch of unaltered savanna in the middle of the forest in the central Amazon (Monte Alegre). According to Silva and Bates (2002), during dry periods in the Glacial Age of Cenozoic, the savannas of northern South America were connected with those of Central Brazil by a savanna corridor via Monte Alegre. Therefore, considering that the genus *Lipoptilocnema* has species associated with savannas of Central Brazil (Mulieri et al. 2016), it is possible to speculate that the distribution of *L. augustoi* sp. nov. in the savannas of Monte Alegre is due to this ancient connection between the savannas, as suggested for other taxa of animals and plants (Prado and Gibbs 1993, Pennington et al. 2000, Silva and Bates 2002, Ingenloff and Peterson 2015). However, due Wallacean shortfalls in collections, it is difficult to understand the historic biogeography of Amazonian savanna species, especially of insects.

In addition, we believe that the species *Argoravinia catiae* Carvalho-Filho and Esposito, 2012, *H. cearensis*, *O. simplicoides*, and *O. excisa* are restricted, in the Brazilian Amazon, to the savannas, as they have not been collected in extensive collections with traps baited with rotting organic matter through the Brazilian Amazon in the last twenty years and they are usually found in savannas and open environments in other regions of Brazil.

Until now, *H. cearensis* has been found only in the biome *caatinga* (a type of semi-arid vegetation) found in northeastern Brazil (Ceará and Bahia) (Tibana 1976, Pape 1996), and its presence in an Amazonian savanna, indicates that this species is associated with dry open-areas.

In Brazil, *O. excisa* has been recorded only for the southern regions (Rio de Janeiro and Minas Gerais) (Pape 1996) and in the savannas of Goiás (Neto de Sousa et al. 2014). This species has not been recorded in the extensive surveys of necrophagous flesh flies performed for years in the secondary and pristine forests in the Brazilian Amazon. Therefore, this is one of the Brazilian Amazon species that seems to be restricted to the savannas, mainly that of the southern portion, which is close to the extensive savanna of Central Brazil.

O. simplicoides was the third most abundant species of *Oxysarcodexia* during the dry period in a savanna in southern Brazil (Minas Gerais) (Rosa et al. 2011), and it has been collected in a forensic study on a pig carcass in a savanna in the northern region (in preparation). This species probably is associated with open vegetation in the Brazilian Amazon, since it has never been collected in the massive collection efforts applied in forested places with rotting organic matter along the rainforest.

A. catiae was described by Carvalho-Filho and Esposito (2012) based on specimens collected in one of the savannas sampled in this study (Serra das Andorinhas, Fig. 1). This species seems to be restricted to open vegetation types since it has been found only in white-sand vegetation (Carvalho-Filho et al. 2018) and Amazonian savannas through the Brazilian Amazon.

We believe that *D. paulistana* is also associated with open and dry environments since it has usually been collected in Brazilian savannas (Barros et al. 2008, Rosa et al. 2011, Mello-Patiu et al. 2014, Faria et al. 2017, Paseto et al. 2019) and in a pasture of Minas Gerais, where it was only collected during the dry and cool season (Paseto et al. 2019).

The genus *Villegasia* Dodge is composed of three species (Pape 1996) that are usually collected in the rotting tissue of vertebrates in coastal environments (Lopes 1938, Barbosa et al. 2015, 2017;

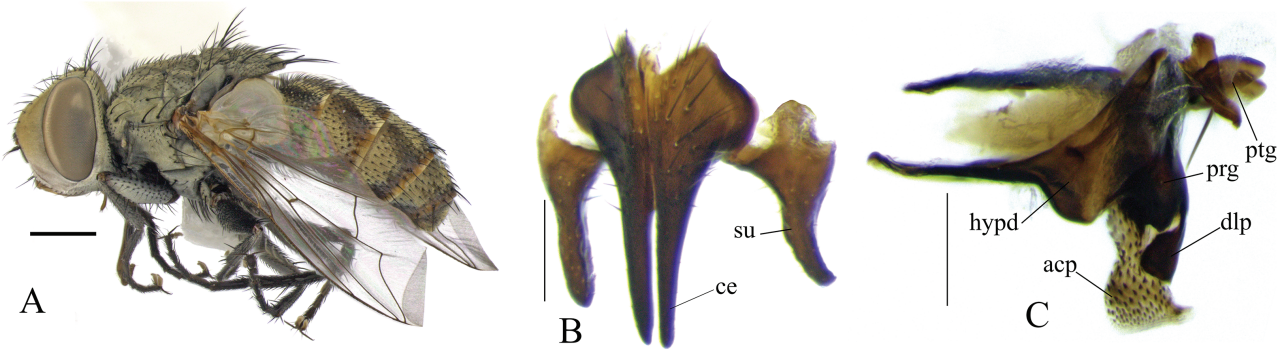

Fig. 6. *Senotainia* sp., male (A) Habitus, left lateral view; scale bar: 1.0 mm. (B) Surstylus and cercus, posterior view; scale bar: 0.2 mm. (C) Phallus and associated structures, lateral view; scale bar: 0.2 mm. Abbreviations: acp = acrophallus; ce = cercus; dlp = dorsal plate; hypd = hypandrium; prg = pregonite; ptg = postgonite; su = surstylus.

Sousa et al. 2016). However, they also occur in other kinds of environments, such as rural areas in Chile (Ortloff et al. 2012). In the Brazilian Amazon, *Villegasia almeidai* is a relatively common species in sand beaches and mangrove forests of the Atlantic coast, but it has never been collected in tropical rain forests. It is the first record of this species in a savanna environment that, like coastal environments, is an open and dry place.

Twenty-eight (70%) species collected in this inventory have been reported as forensically important species in previous studies (Table 1). This high number may be due the utilization of traps baited with rotting vertebrate tissue. Most of these species belong to the genera *Oxysarcodexia* Townsend, 1917 and *Peckia* Robineau-Desvoidy, 1830 which are among the most species-rich and abundant sarcosaprophagous genera in the Neotropics (Pape 1996, Buenaventura and Pape 2013, Souza et al. 2020). The genus *Lipoptilocnema* comprises species with forensic importance that have been collected with traps baited with rotting vertebrate tissues and pig carcasses (Mulieri et al. 2016), but the only species recorded in this inventory, *L. augustoi* sp. nov., was collected only with yellow pan traps.

Although Amazonian savannas are distinct and unique environments, they are under-protected and highly threatened (Carvalho and Mustin 2017). Most of the savannas sampled in this study were located in unprotected areas, where we recorded some anthropic activities that are drastically changing the landscape, such as fires, soy monocultures, and sand extraction for constructions (Fig. 2E and F). Considering that some species of flesh flies and of other taxa occur in or are restricted to Amazonian savannas, the protection of the unique habitats is of special concern, because their fauna could soon be either totally or locally extinct.

Acknowledgments

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